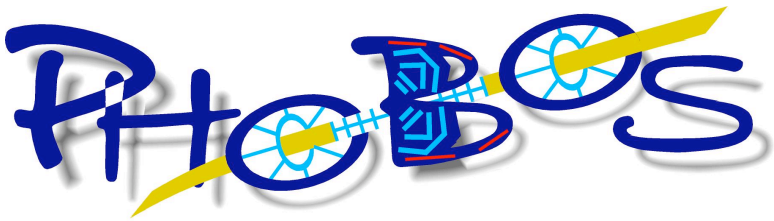
Flow in AuAu Collisions at RHIC

Marguerite Belt Tonjes
University of Maryland

for the PHOBOS Collaboration



The PHOBOS Collaboration



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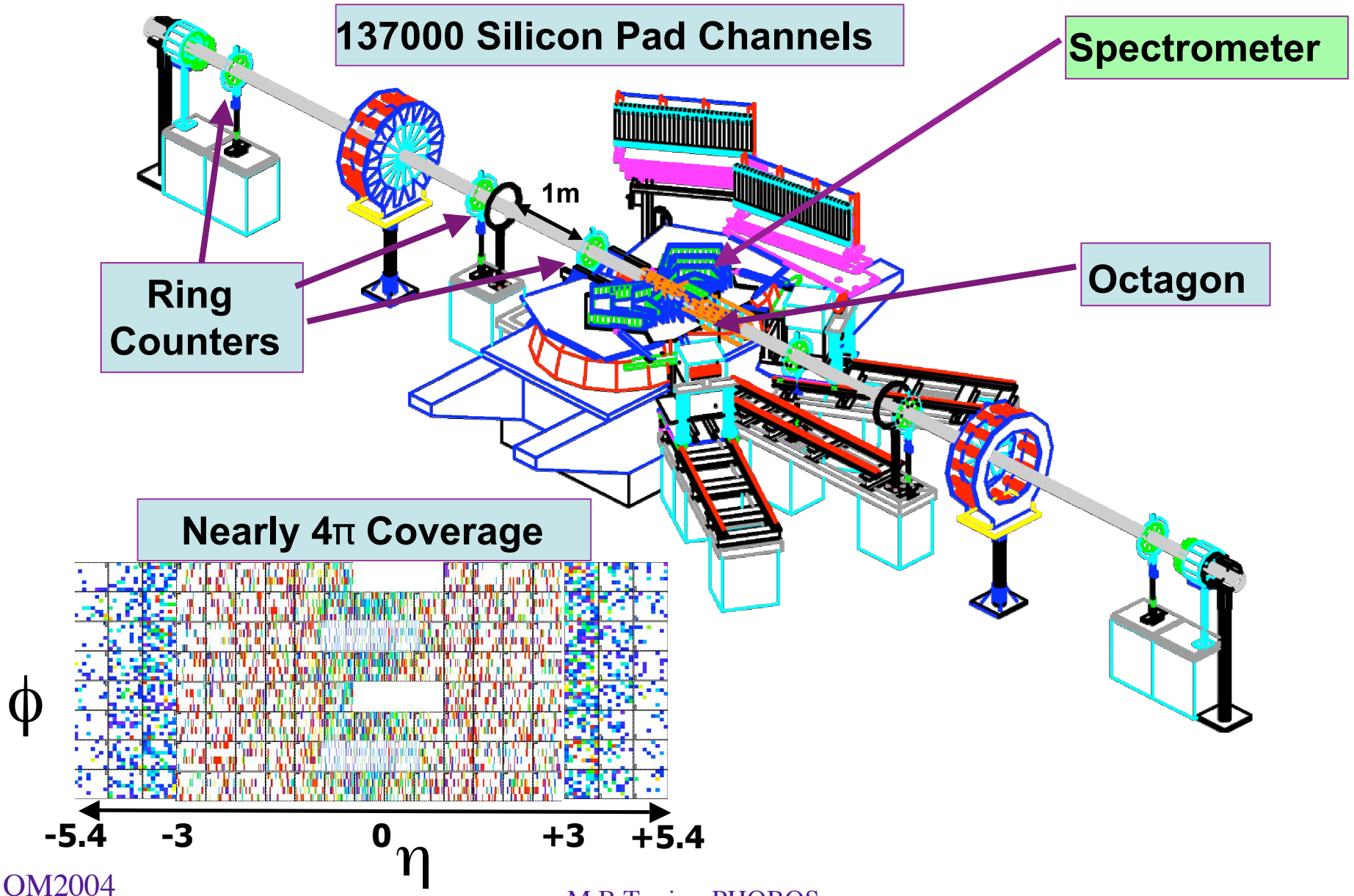
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
UNIVERSITY OF ILLINOIS AT CHICAGO
UNIVERSITY OF ROCHESTER

PHOBOS Collaboration meeting, BNL
Chemistry building, October 2002

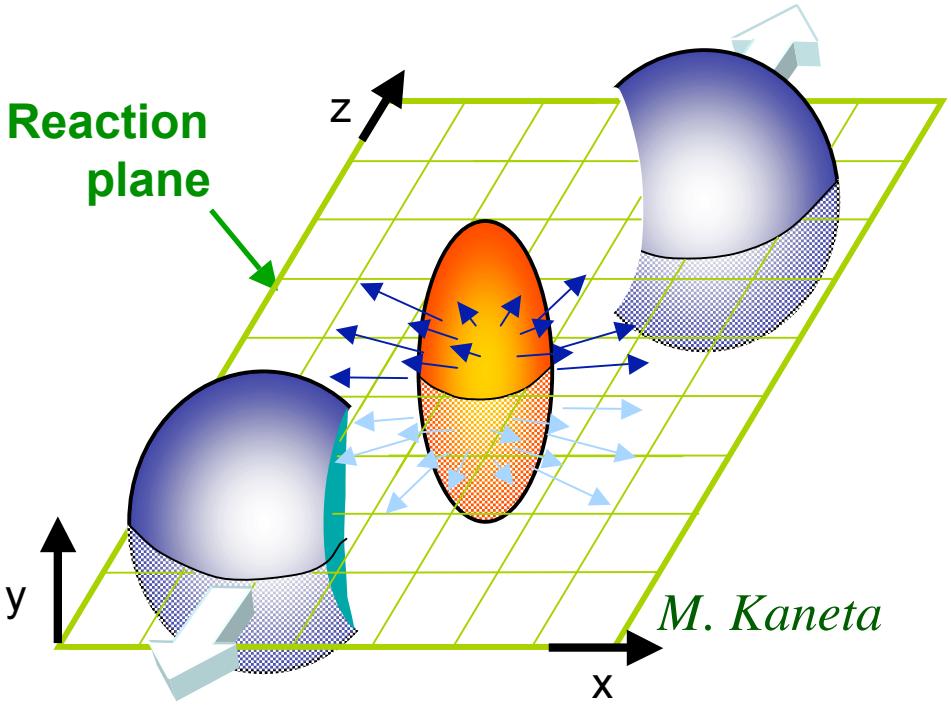
PHOBOS Detector 2000(2001)



Why measure flow?

- Flow is thought to be generated by compression in the early stages of the collision
- Flow probes the thermalization of the system
- Elliptic and directed flow probe the evolution of the system

Flow



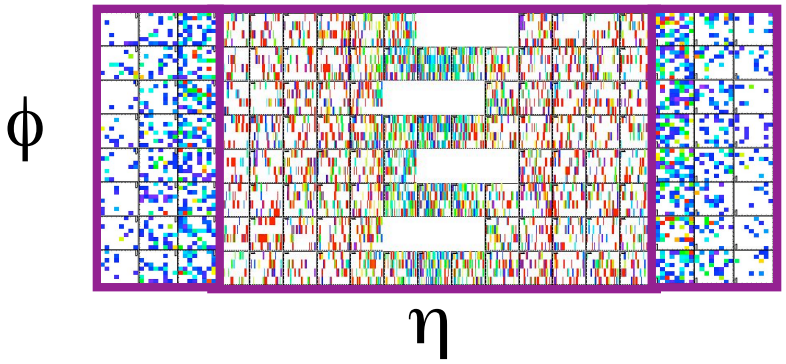
Flow measured by decomposing the azimuthal angle particle distributions into Fourier components:

$$\frac{dN}{d(\phi - \Psi_R)} \propto 1 + 2\mathbf{v_1}cos(\phi - \Psi_R) + 2\mathbf{v_2}cos(2(\phi - \Psi_R)) + \ldots$$

directed flow **elliptic flow**

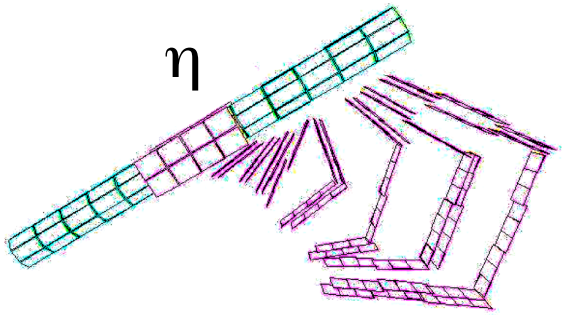
Measuring flow in PHOBOS

Hit-based method



- Large η coverage
- Event-by-event
- Uniform acceptance in ϕ
- Separated subevents
- Does not require large event sample

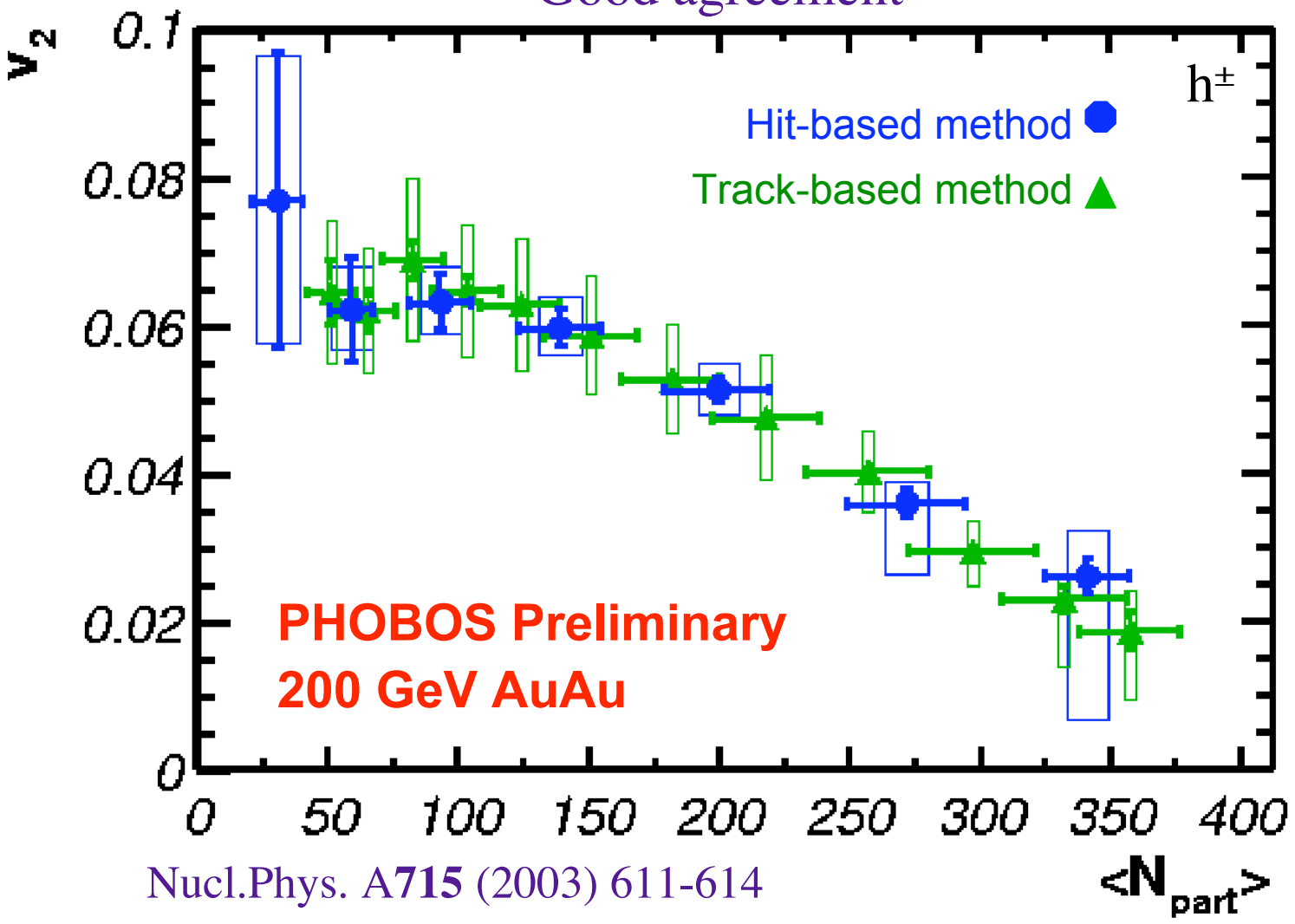
Track-based method



- Measures p_t dependence of v_2
- Use of tracks reduces background effects and reduces MC dependence
- Subevents and tracks widely separated in η

$v_2(N_{part})$ with two methods

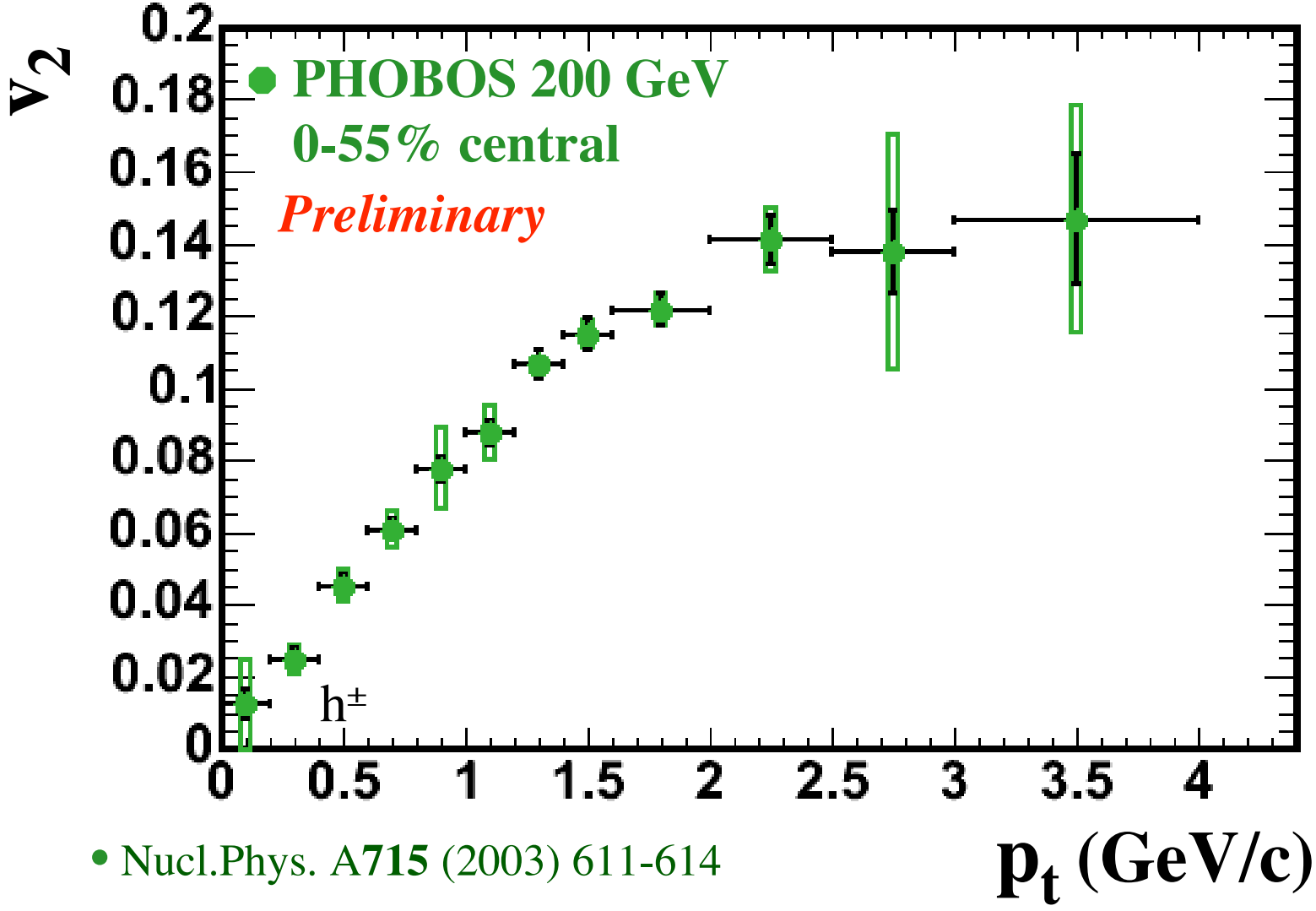
Good agreement



Nucl.Phys. A**715** (2003) 611-614

v_2 vs. p_t AuAu

track-based method



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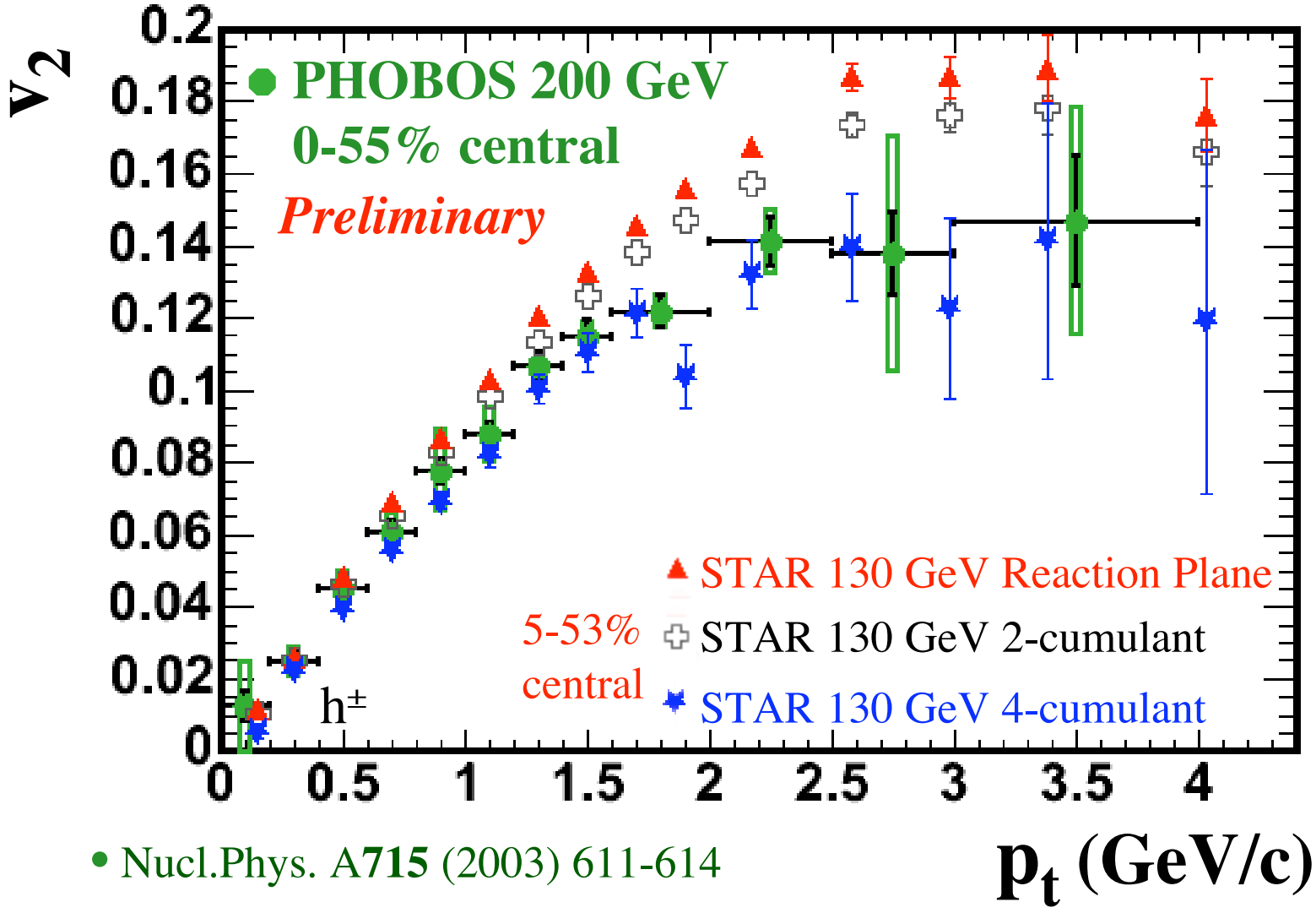
v_2 vs. p_t AuAu

track-based method



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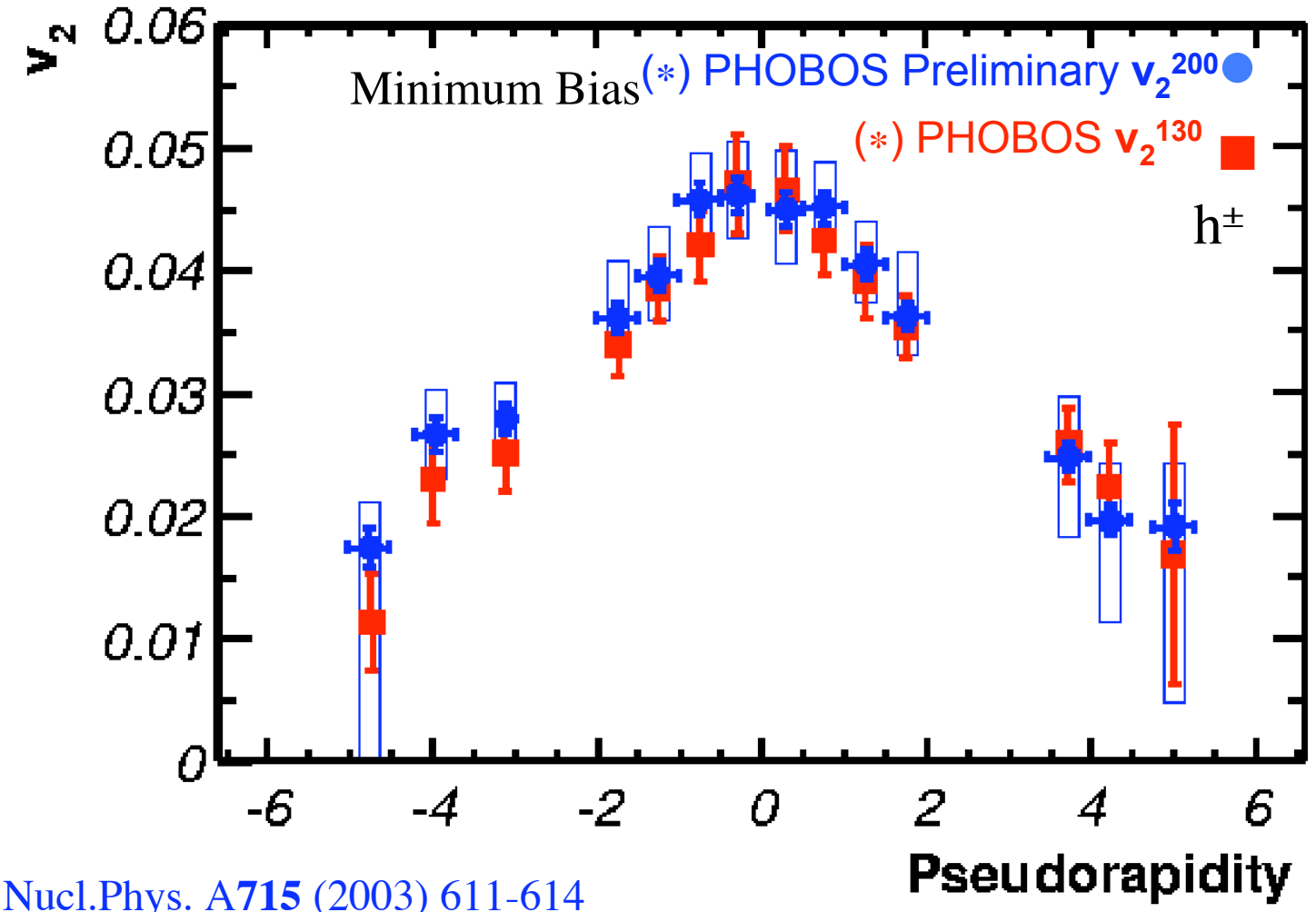
v_2 vs. η at 130 and 200 GeV AuAu

Hit-based method

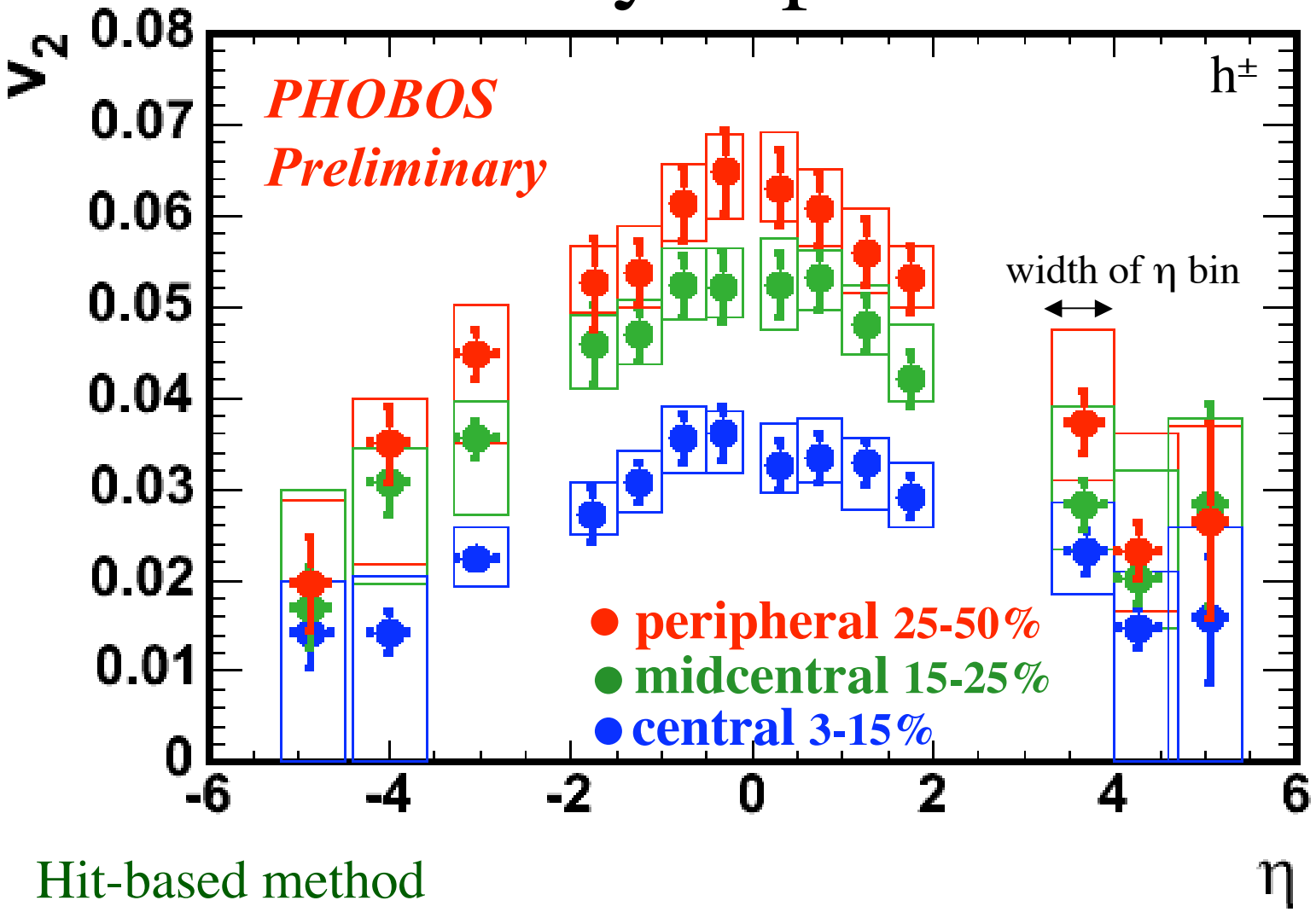


(*) Nucl.Phys. A**715** (2003) 611-614

(*) PRL **89**, 222301 (2002)

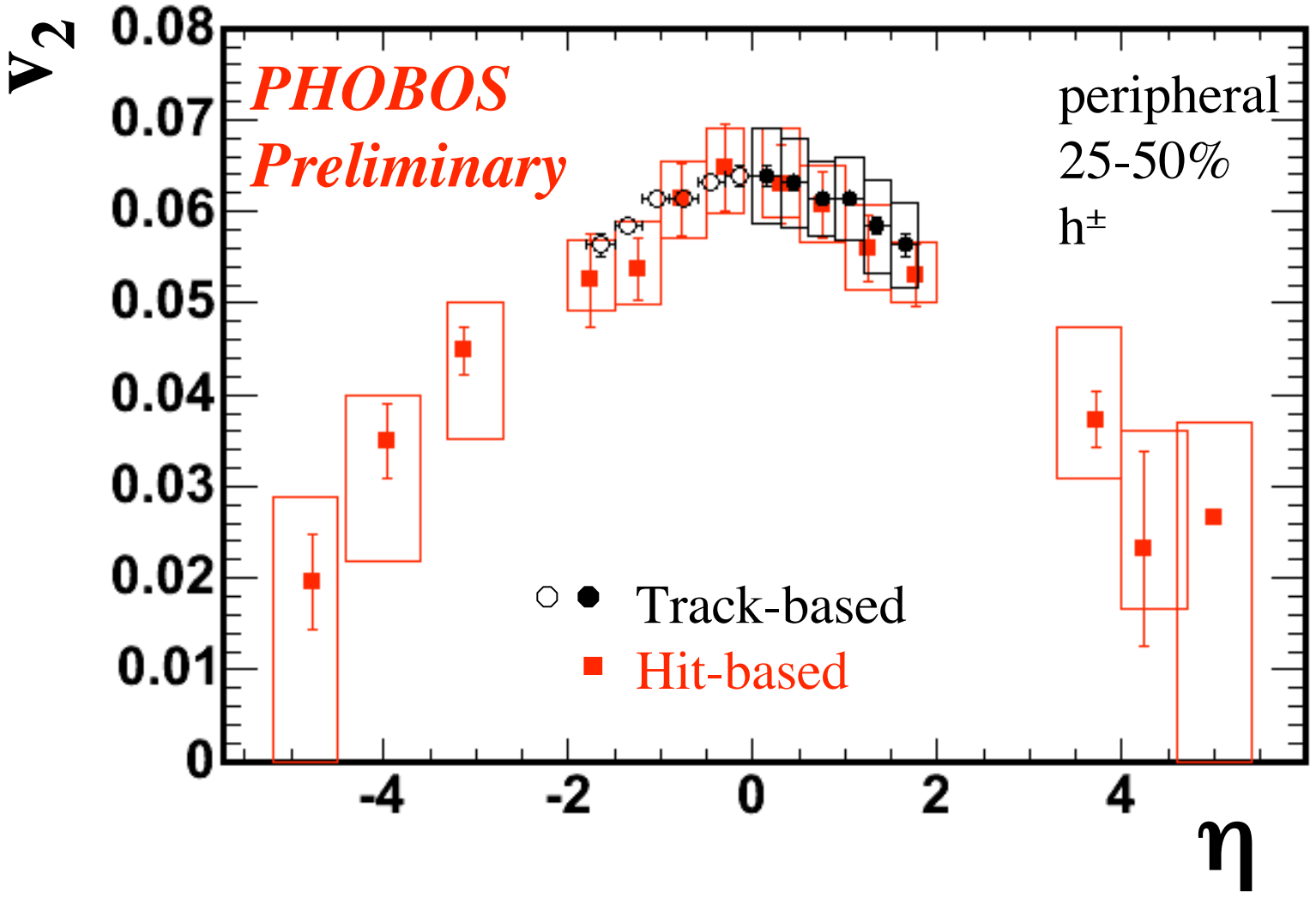
v_2 has a strong dependence on η

v_2 vs. η at 200 GeV AuAu - centrality dependence

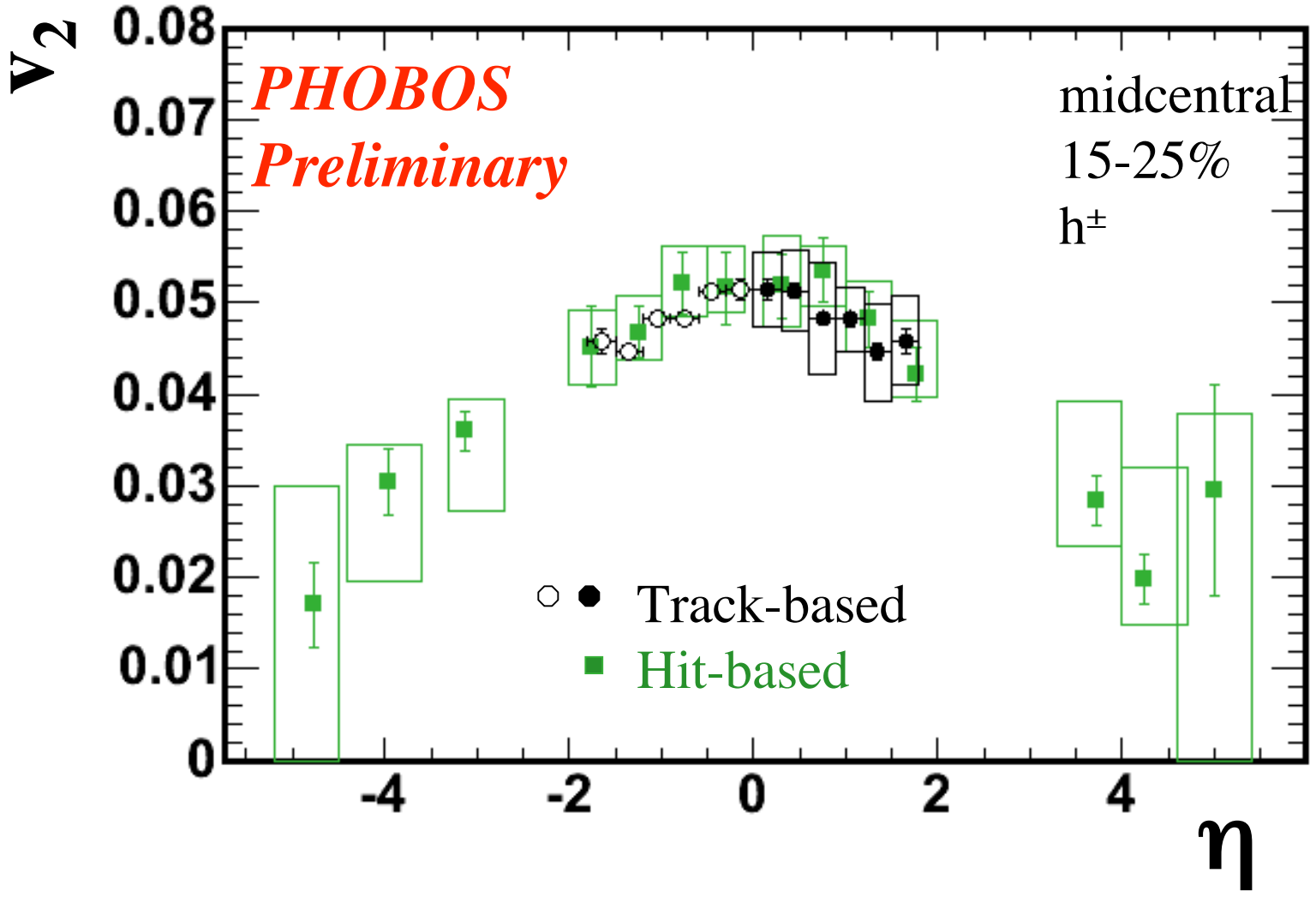


Hit-based method

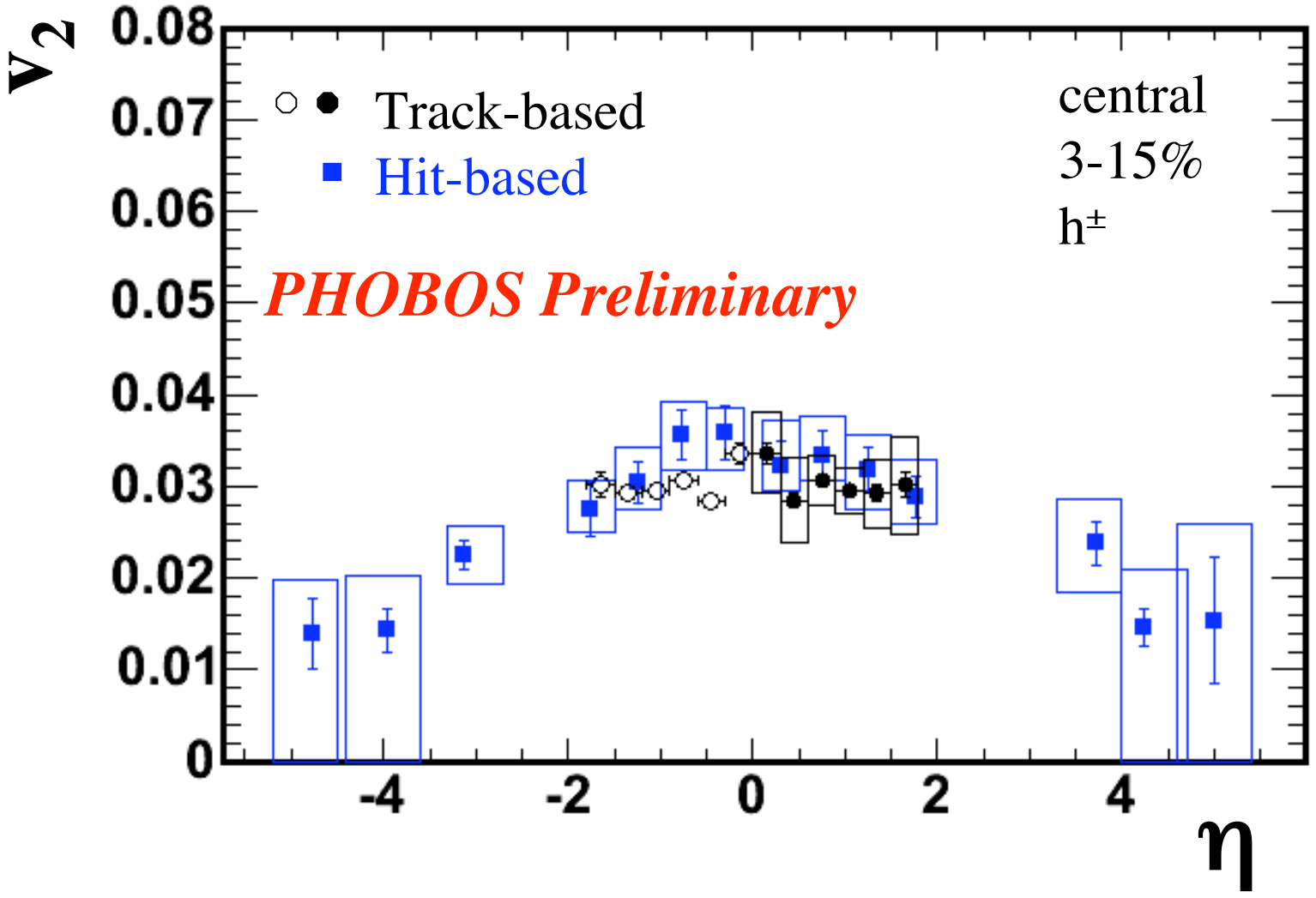
v_2 vs. η at 200 GeV AuAu - comparison of methods



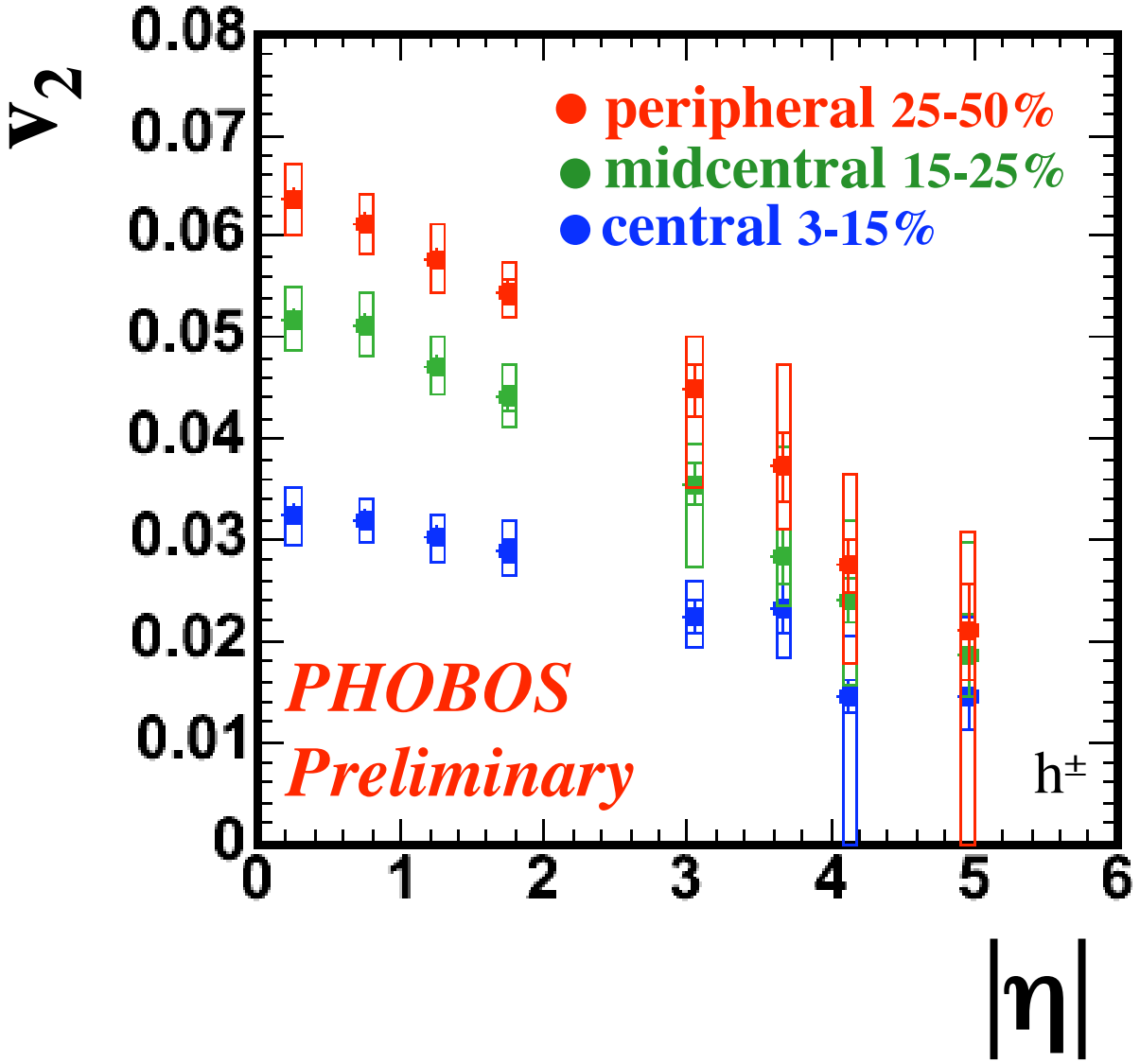
v_2 vs. η at 200 GeV AuAu - comparison of methods



v_2 vs. η at 200 GeV AuAu - comparison of methods

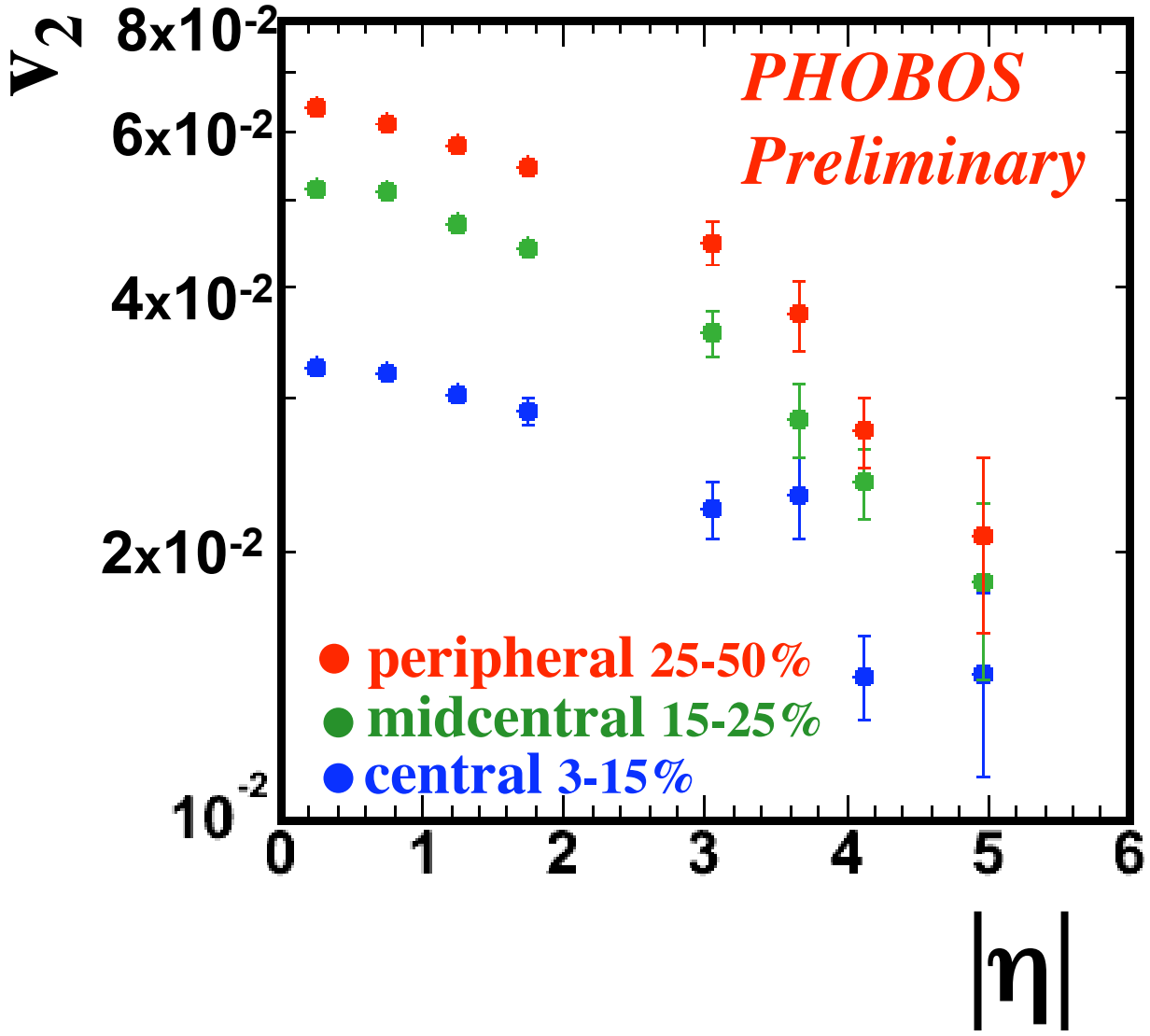


Hit-based & track-based data combined



- The peripheral data at midrapidity is not flat within 90% confidence level
- Different centralities appear to differ only by a scale factor (within errors)

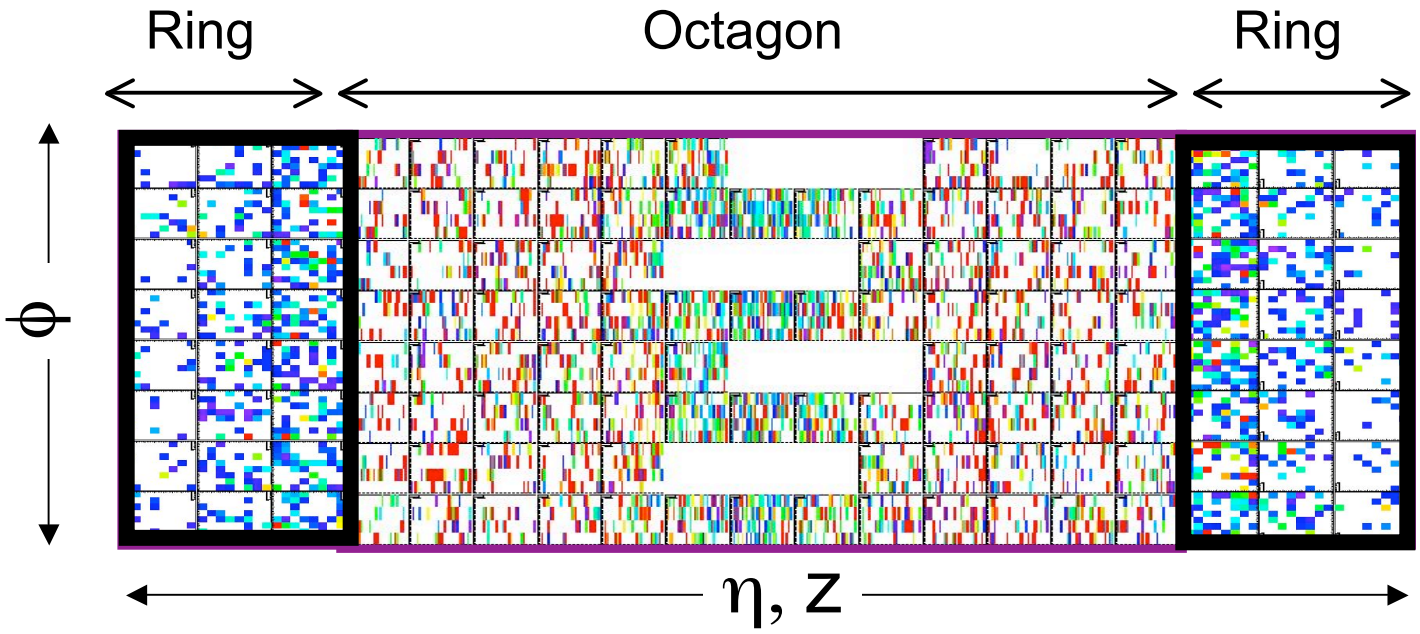
Hit-based & track-based data combined



- The peripheral data at midrapidity is not flat within 90% confidence level
- Different centralities appear to differ only by a scale factor (within errors)

v_1 measurement: hit-based method

$$\frac{dN}{d(\phi-\Psi_R)} \propto 1+2\mathbf{v_1}cos(\phi-\Psi_R)+2v_2cos(2(\phi-\Psi_R))+\ldots$$

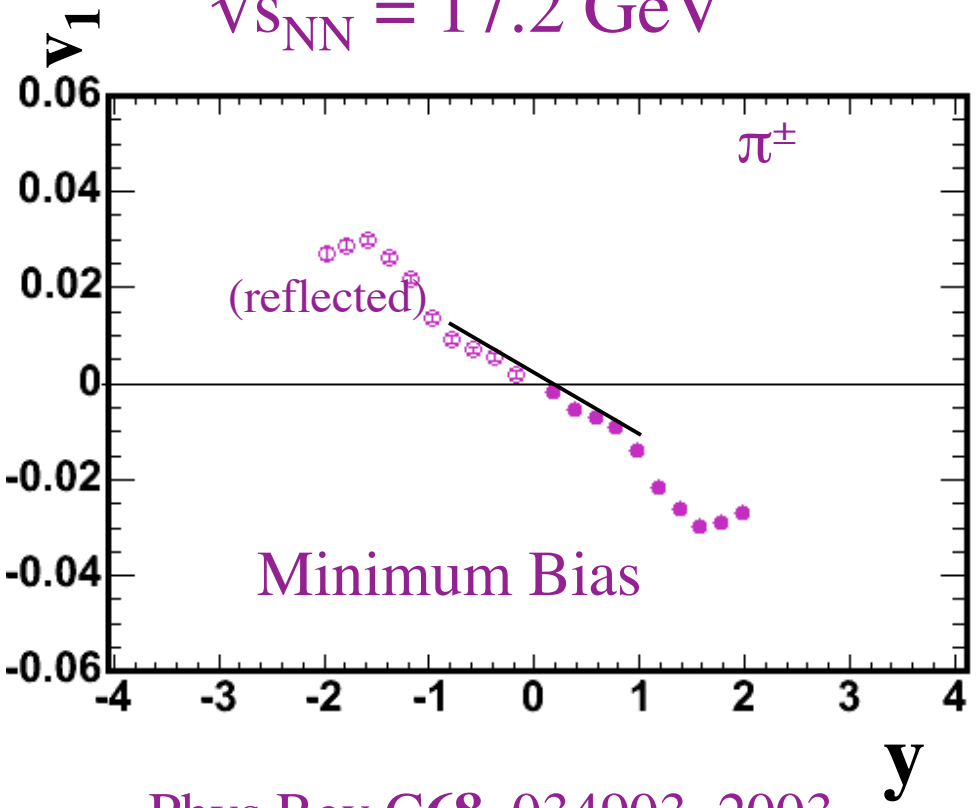


- Reaction plane for Octagon calculated from symmetric subevents in the Rings (and vice-versa)

v_1 measured at different energies

NA49 PbPb 158 GeV

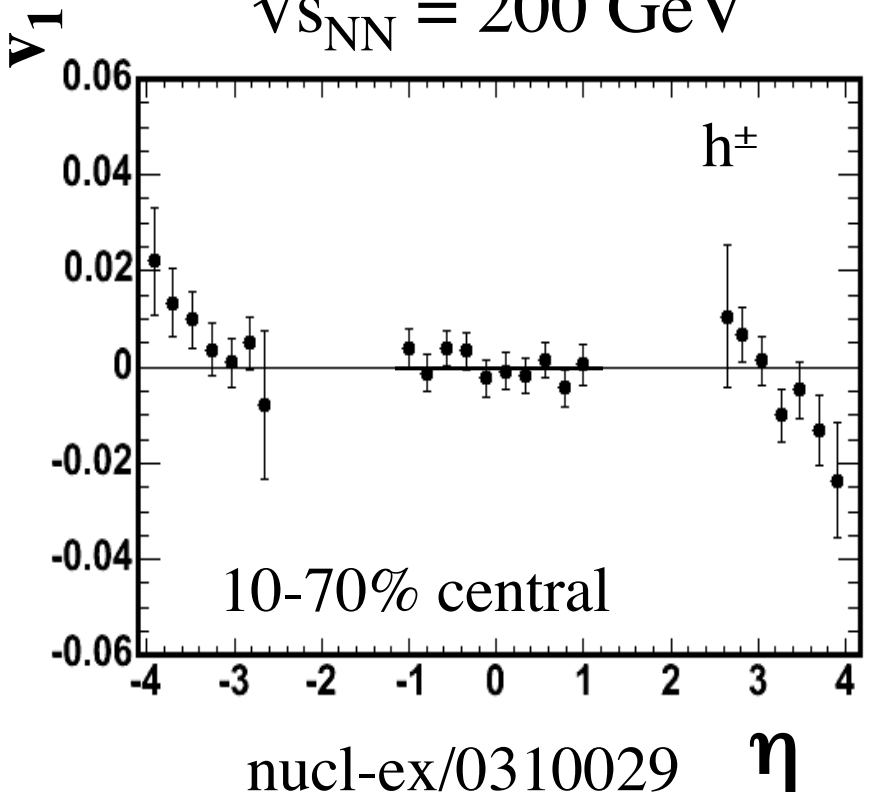
$\sqrt{s_{NN}}$ = 17.2 GeV



Phys.Rev.C**68**, 034903, 2003

STAR AuAu

$\sqrt{s_{NN}}$ = 200 GeV



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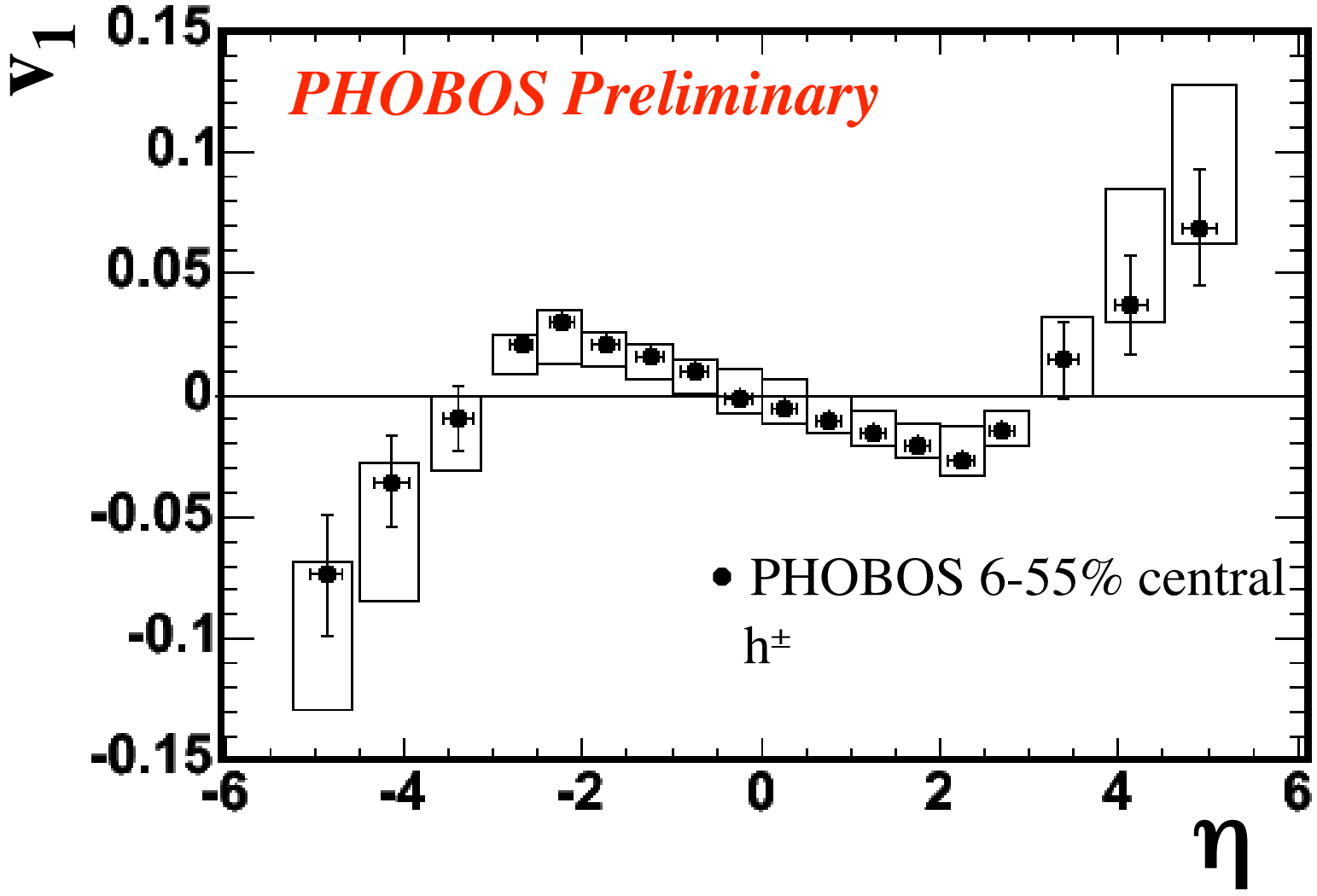
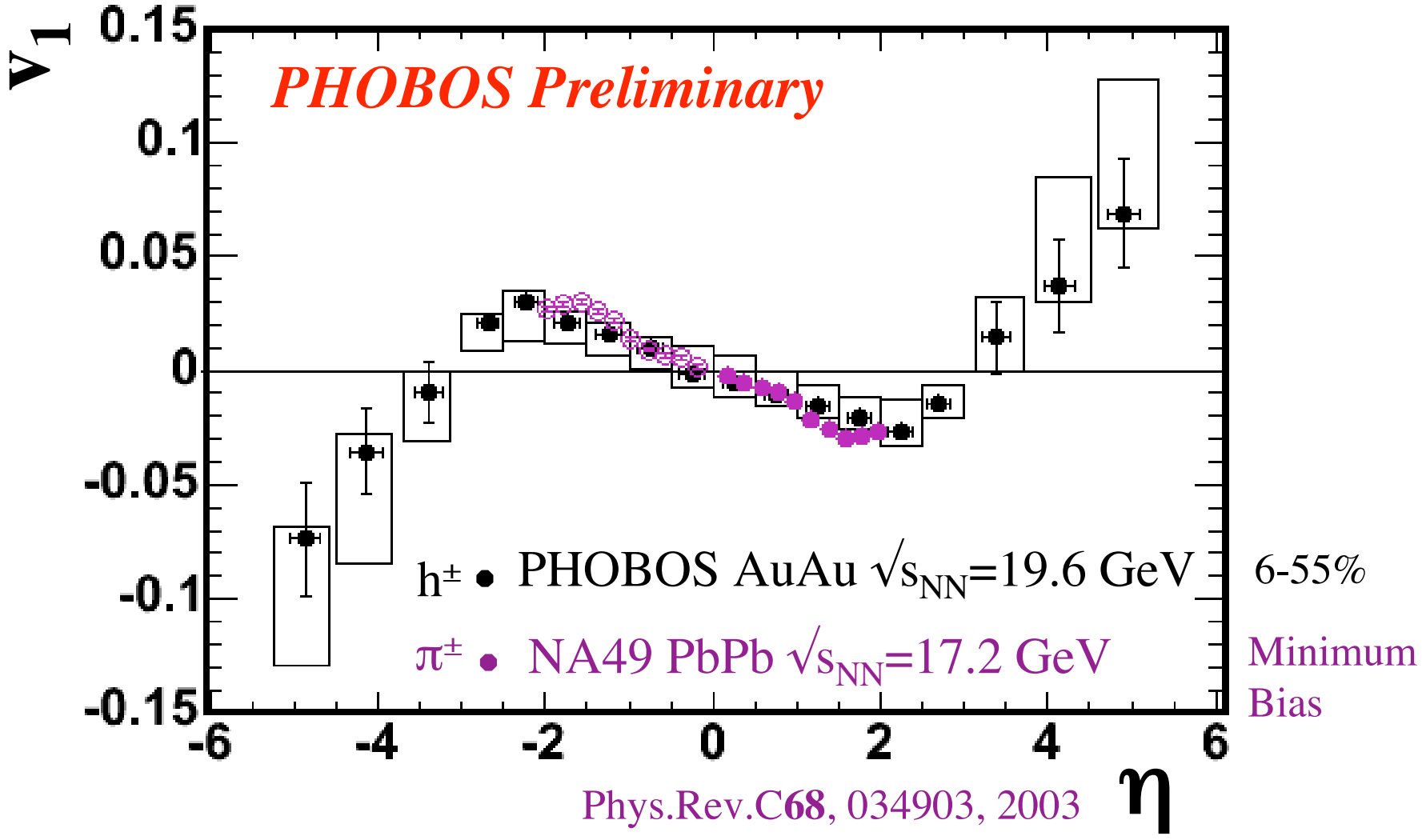
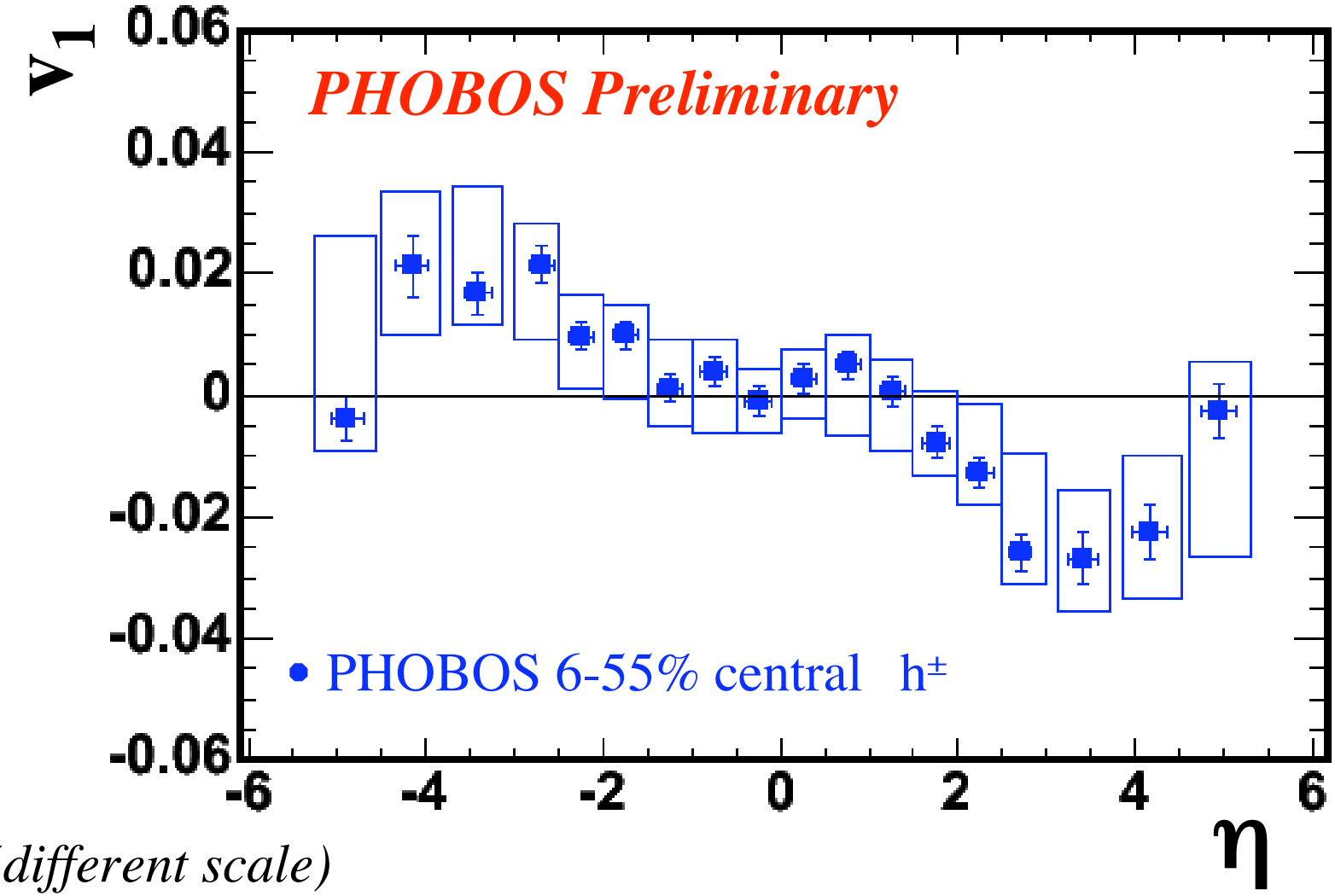
v_1 at 19.6 GeV AuAu



v_1: 19.6 GeV AuAu & 17.2 GeV PbPb

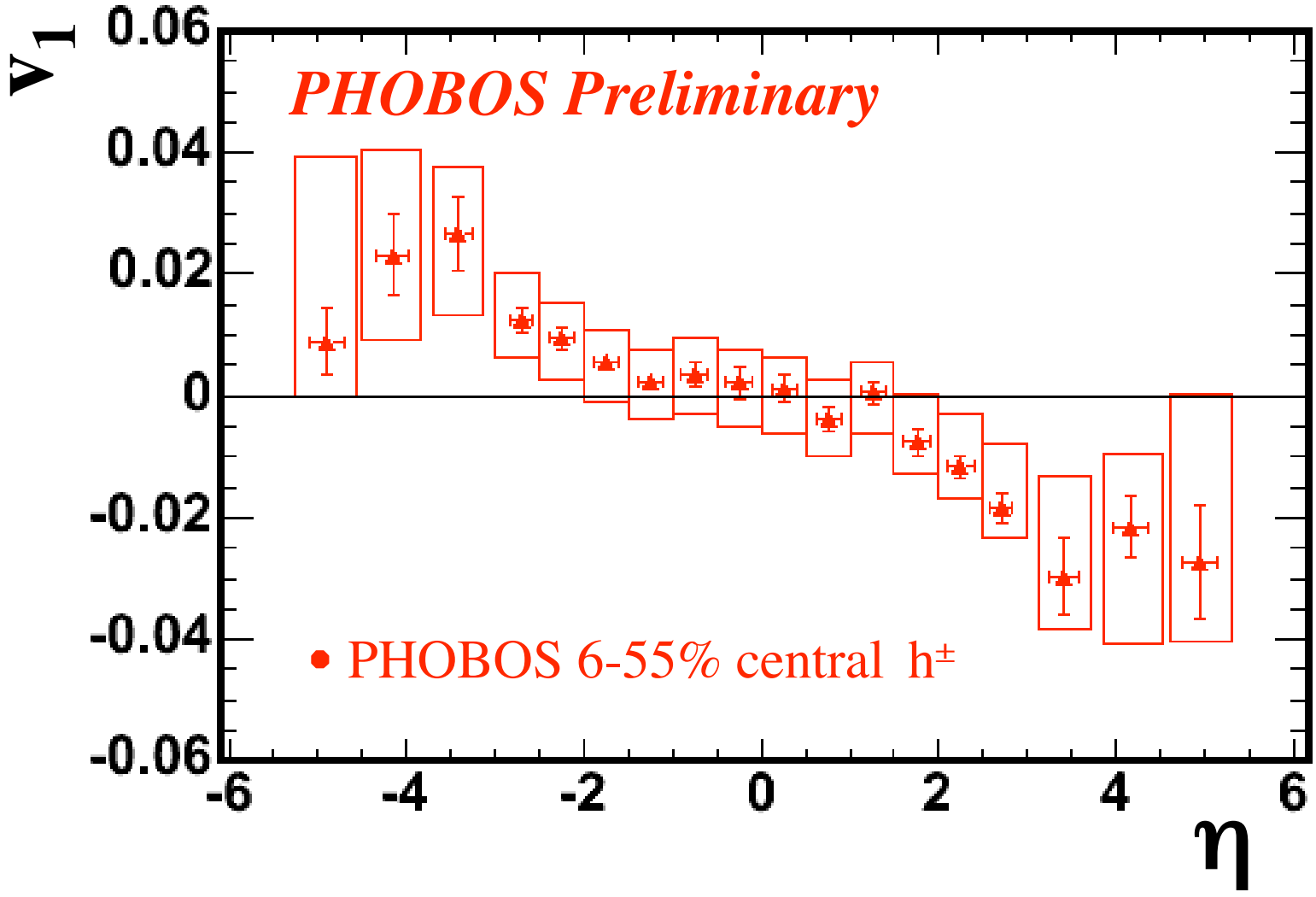


v_1 at 130 GeV AuAu

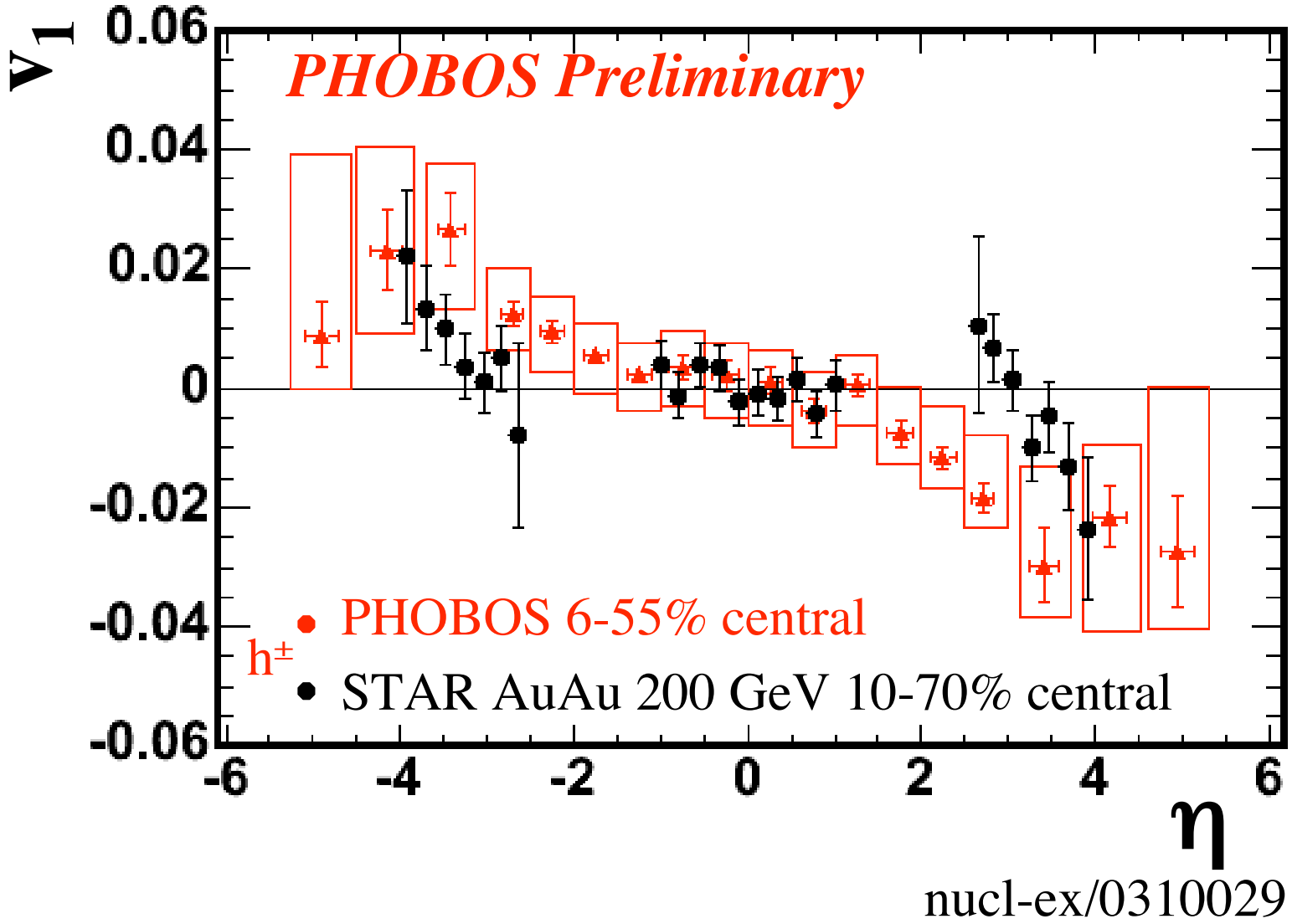


(different scale)

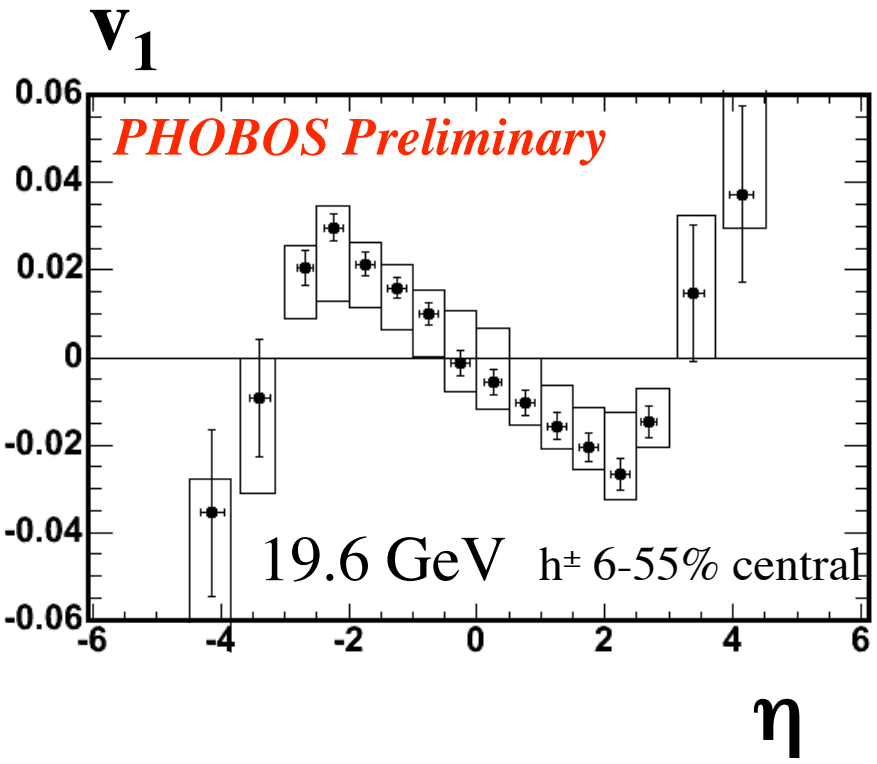
v_1 at 200 GeV AuAu

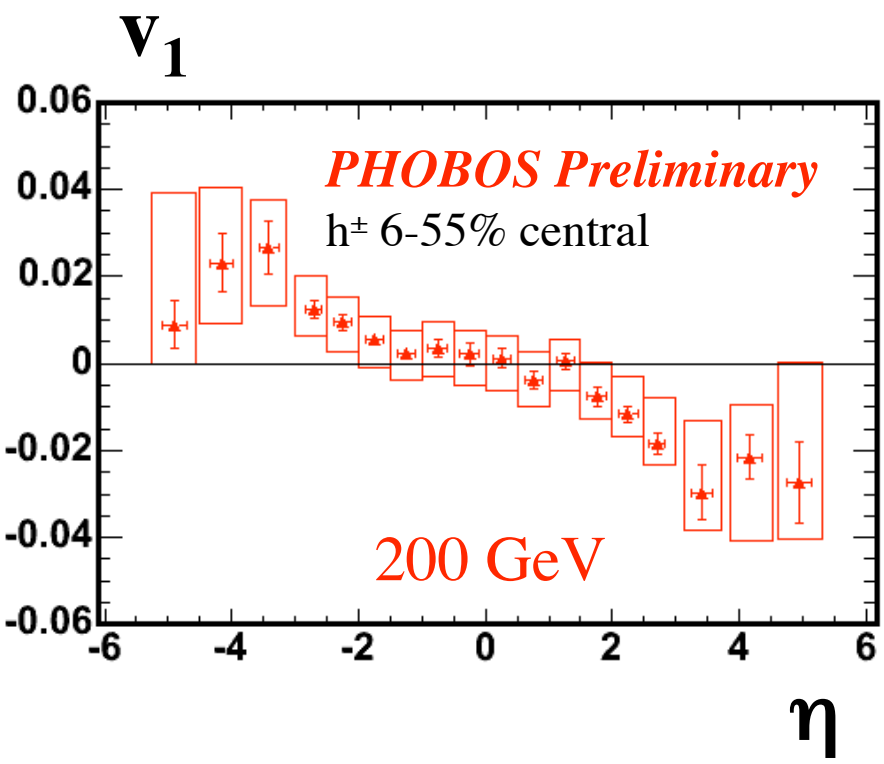


v_1 at 200 GeV AuAu:PHOBOS & STAR



v_1 at different energies in AuAu





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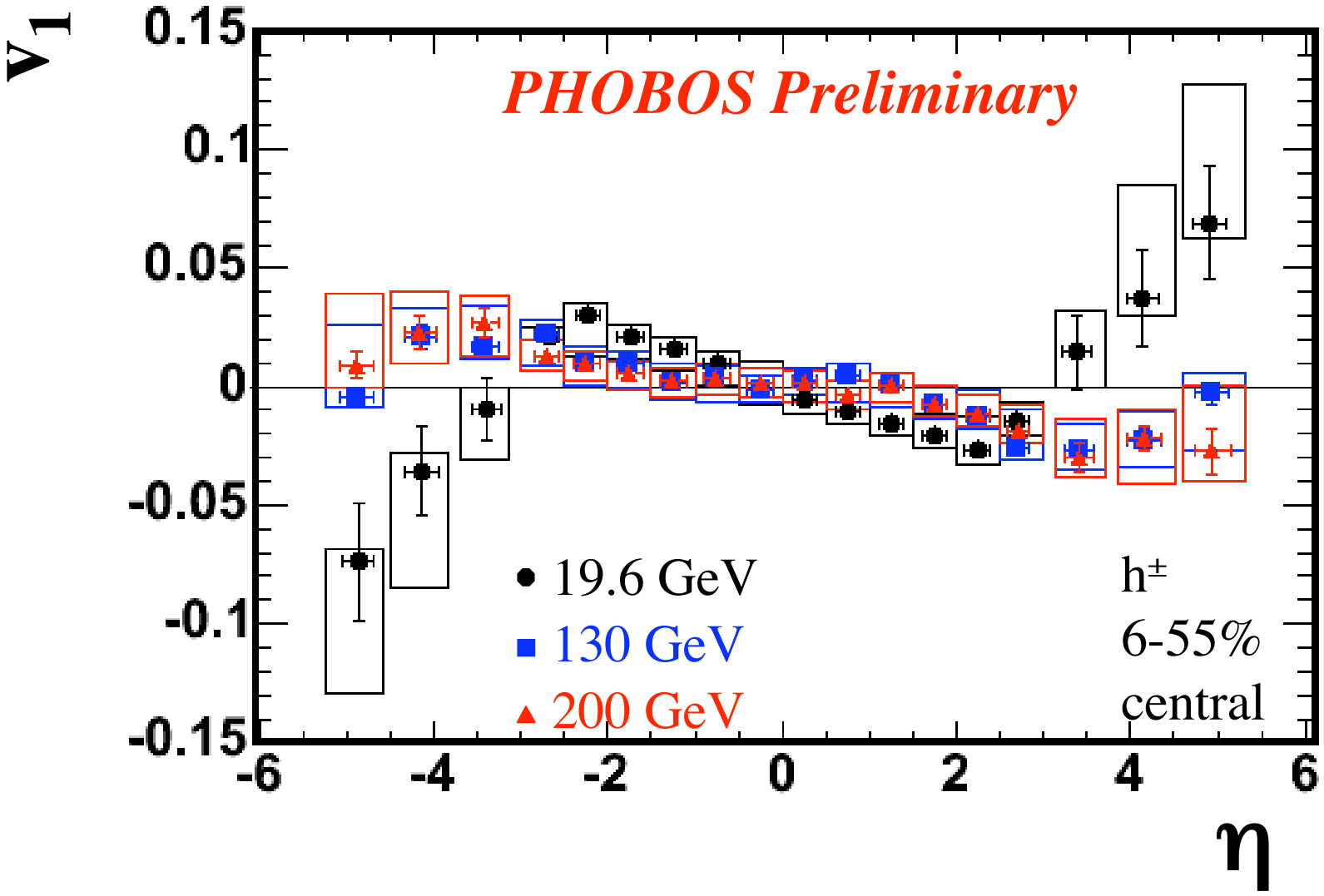
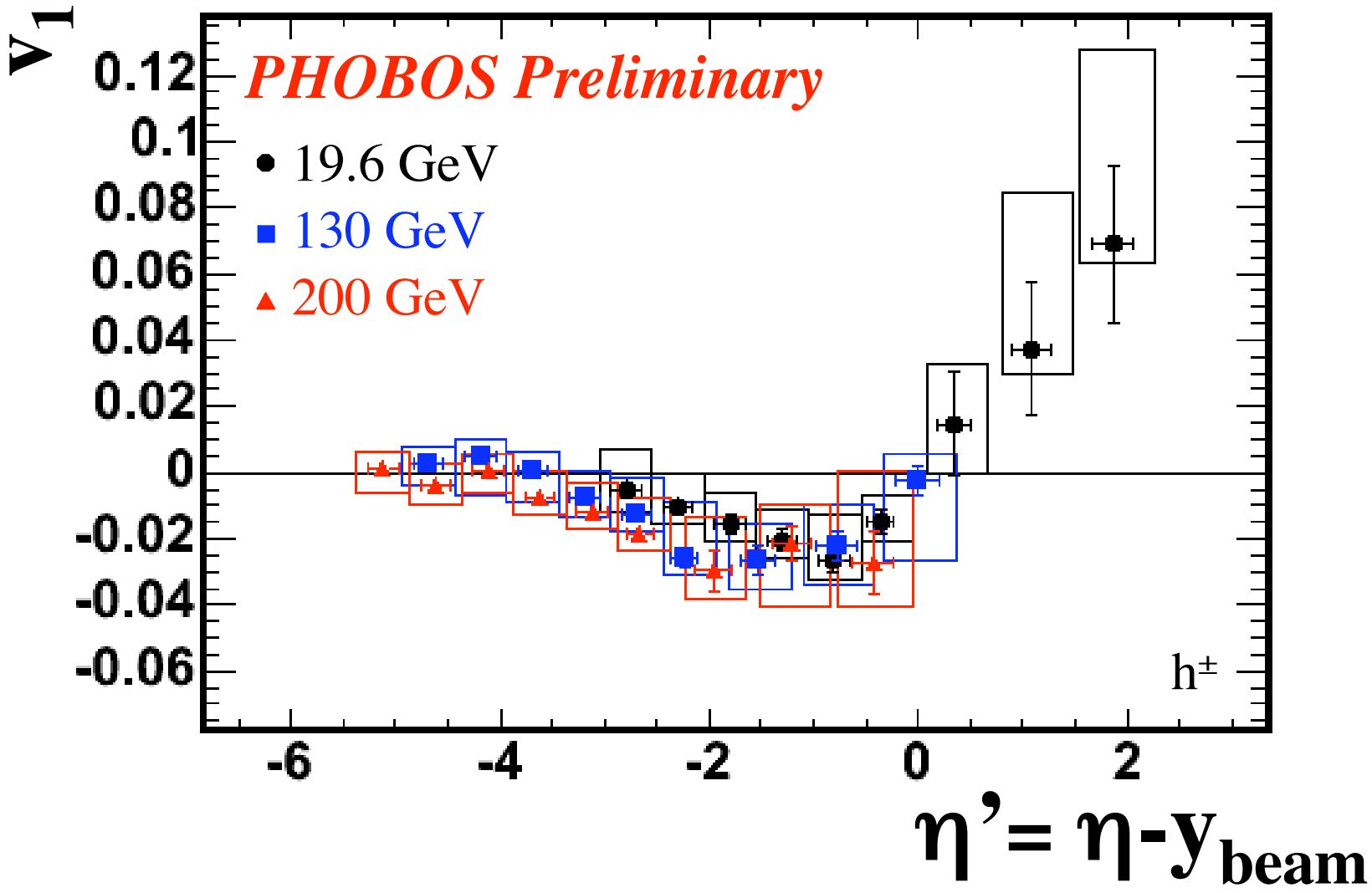
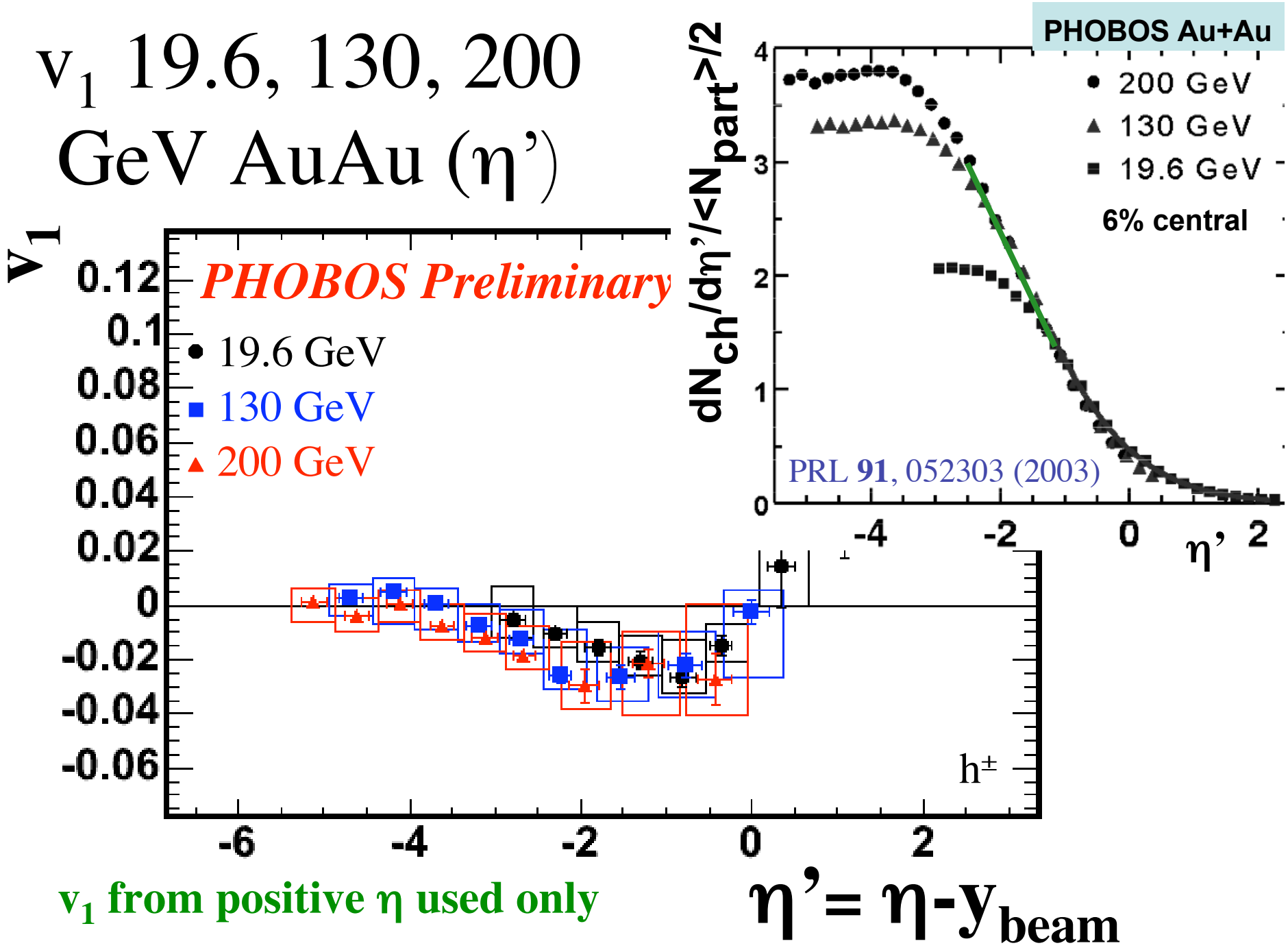


v_1 19.6, 130, 200 GeV AuAu (η')



v_1 19.6, 130, 200 GeV AuAu (η')



Conclusions

- v_2 vs p_t demonstrates that we do not measure significant non-flow effects
- v_2 has been measured as a function of η and centrality over a large range in pseudorapidity
- v_1 has been measured over a range of energies from 19.6 to 200 GeV over a large region of η in PHOBOS
- v_1 clearly changes behavior from low (19.6 GeV) to high (200 GeV) energy
- v_1 in the mid-η' region is reminiscent of limiting fragmentation